Effects of Hospital Policies Based on 1996 Group B Streptococcal Disease Consensus Guidelines

STEPHANIE H. FACTOR, MD, MPH, CYNTHIA G. WHITNEY, MD, MPH, SARA S. ZYWICKI, MPH, AND ANNE SCHUCHAT, MD, FOR THE ACTIVE BACTERIAL CORE SURVEILLANCE TEAM

***Objective*: To determine whether the 1996 consensus guidelines for prevention of early-onset group B streptococcal disease developed by the Centers for Disease Control and Prevention, ACOG, and the American Academy of Pediatrics are affecting obstetric practice and disease occurrence.**

***Methods*: Personnel in hospitals with obstetric services in seven surveillance areas completed surveys about their programs, patient populations, and group B streptococcal disease prevention policies. Survey results were linked to group B streptococcal disease cases identified by active surveillance in 1996 and 1997. An early onset case was defined as a case in which group B streptococci were isolated from a sterile site in the 1st 6 days of life. The number of cases in 1996 and 1997 were compared using a paired *t* test. Linear regression was used to assess hospital characteristics associated with group B streptococcal disease cases.**

***Results*: Of 177 hospitals, 165 (93%) responded, and 96 (58%) of those had group B streptococcal disease prevention policies. Hospitals that established or revised their policies in 1996 had a lower mean number of cases in 1997 than in 1996 (0.58 versus 1.29, $P = .006$). Linear regression analysis, controlling for number of births, indicated that a hospital's having more black mothers and location in particular states were associated with more cases of disease. Citing the 1996 ACOG reference as the source for hospital group B streptococcal disease prevention policy was associated with fewer cases of group B streptococcal disease ($P = .038$).**

***Conclusion*: The publication and adoption of the guidelines were associated with decreasing occurrence of group B streptococcal disease. (Obstet Gynecol 2000;95:377–82.)**

Infection with group B streptococci is a leading cause of neonatal sepsis, pneumonia, and meningitis. Before prevention policies were widespread, group B streptococcal infection caused an estimated 7600 cases of serious illness and 310 deaths among infants less than 90 days old in the United States in 1990.[1] Approximately 80% of infections occurred in infants less than 7 days old (early-onset disease).[2] Most cases of early-onset group B streptococcal disease can be prevented by treating pregnant women with intravenous antibiotics during labor.[3,4] During 1992, the American Academy of Pediatrics[5] and ACOG[6] issued independent statements on prevention strategies. The statements identified which women were at risk of having children with group B streptococcal disease and outlined when and how to provide intrapartum antibiotics to them.

In 1994, the Centers for Disease Control and Prevention (CDC) conducted a survey of hospitals in several states where surveillance for invasive group B streptococcal disease was ongoing, to determine whether prevention policies had been adopted and whether such policies had a measurable effect on early-onset group B streptococcal disease.[7] After adjusting for number of births, there were more cases of early-onset group B streptococcal disease in hospitals with more deliveries by black women and women with no prenatal care. By 1994, only 35% of obstetrics departments had policies on group B streptococcal disease prevention. After controlling for black race and prenatal care, departments with screening policies had significantly less early-onset disease.

From the Respiratory Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention; and the Epidemic Intelligence Service, Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, Georgia.

The Active Bacterial Core Surveillance Team of the Emerging Infection Program Network: P. Daily, MPH, L. Gelling, MPH, N. Mukerjee, MPH, G. Rothrock, MPH, A. Reingold, MD, D. Vugia, MD, S. Waterman, MD (California); C. Morin, MPH, Q. Phan, MPH, N. Barrett, MS, MPH, P. Mshar, J. Hadler, MD, MPH (Connecticut); W. Baughman, MSPH, M. Farley, MD, P. Blake, MD (Georgia); L. Harrison, MD, L. Billmann, RN, MPH (Maryland); J. Rainbow, MPH, R. Lynfield, MD, MPH, R. Danila, PhD (Minnesota); K. Stefonek, BSN, MPH, J. Donegan, RN, M. Cassidy, MT(ASCP), SM, P. Cieslak, MD, D. Fleming, MD (Oregon); B. Barnes, RN, C. Gilmore, RN, L. Lefkowitz, MD (Tennessee).

Supported by the National Center for Infectious Diseases Emerging Infections Program, Centers for Disease Control and Prevention.

0029-7844/00/$20.00

PII S0029-7844(99)00549-9

In 1996, the CDC, in collaboration with ACOG and the American Academy of Pediatrics, issued consensus guidelines for preventing early-onset group B streptococcal disease. Each organization published identical guidelines in formats specifically targeted to their constituencies. The CDC[8] published a supplement to the *Morbidity and Mortality Weekly Report* on May 31, 1996; ACOG[9] distributed a Committee Opinion to members on June 1, 1996; and the American Academy of Pediatrics[10] published the guidelines in the March 1997 issue of *Pediatrics*. Using one of two strategies was recommended in the guidelines: the screening approach, in which vaginal and rectal culture specimens are obtained from women at 35–37 weeks' gestation to determine whether there is group B streptococcal colonization, with those who are culture positive or who deliver preterm being given antibiotics during labor; and the risk-based approach, in which all women with prolonged membrane rupture (at least 18 hours), premature delivery (before 37 weeks), or fever during labor (temperature of at least 38.0C) are given antibiotics during labor. In both strategies, women with group B streptococci in their urine during pregnancy and women with previous infants with group B streptococcal disease are given intrapartum antibiotics.

This study was a survey of hospitals in several states where surveillance for invasive group B streptococcal disease was ongoing. Study objectives were to determine whether publication of group B streptococcal guidelines in 1996 influenced adoption of prevention policies and whether adoption of those policies had measurable effects on group B streptococcal disease.

Materials and Methods

The study was conducted in all hospitals with obstetric services in the seven geographic areas of the CDC Active Bacterial Core Surveillance system for monitoring group B streptococcal disease. The surveillance areas were the 20-county Atlanta area ($n = 31$ hospitals), the three-county San Francisco Bay area ($n = 24$), the seven-county Minneapolis–St. Paul, Minnesota, area ($n = 20$), the three-county Portland, Oregon, area ($n = 13$), five urban counties in Tennessee ($n = 24$), and the entire states of Connecticut ($n = 30$) and Maryland ($n = 35$).

To collect data on hospital characteristics and group B streptococcal disease prevention policies, we mailed structured questionnaires to each hospital during fall 1997. Hospital infection control practitioners identified the best informant for each hospital. The survey included questions about obstetrics program characteristics (including academic affiliations and neonatal intensive care units [NICUs]), characteristics of obstetric patient populations (including race-ethnicity, percentage who had prenatal care, percentage insured, and percentage who received public medical assistance), and group B streptococcal disease prevention policies (including when policies were established, what sources policies were based on, which strategies were used, and how policies were implemented). Surveillance coordinators reminded survey nonresponders by facsimile or telephone.

Survey results were linked with the number of early-onset group B streptococcal disease cases for each hospital. A case of early-onset group B streptococcal disease was defined as a case in which group B streptococci were isolated from a sterile site (eg, blood or cerebrospinal fluid) in the 1st 6 days of life. Infants studied were born in active surveillance areas in 1996 or 1997. Early-onset cases of group B streptococcal disease were identified by active surveillance methods reported previously.[1,2] Surveillance personnel regularly contacted their local microbiology laboratories to identify cases of invasive group B streptococcal disease in surveillance area residents. Laboratory records were audited every 6 months to ensure complete reporting. Cases of early-onset group B streptococcal disease were attributed to birth hospitals in infants transferred or admitted to other hospitals.

To identify effects institutional policies might have had after the 1996 guidelines, we grouped hospitals as follows: those without group B streptococcal disease prevention policies, those that established or revised policies in 1996, and those with policies that were not established or revised in 1996. The latter group included hospitals that did not provide dates of establishment of policies, hospitals that established policies before 1996 and did not revise them in 1996, and hospitals that established policies after 1996. We compared the average number of group B streptococcal disease cases in 1996 with the average number in 1997 in each group using a paired t test. Only hospitals that were under active surveillance for all of 1996 and 1997 were included in this analysis.

To identify possible demographic, hospital, and policy risk factors associated with the number of group B streptococcal disease cases, we used linear regression with number of group B streptococcal cases in 1997 as the outcome and we controlled for number of births. We limited our analysis to hospitals that were under active surveillance for all of 1997. Factors potentially associated with the number of cases ($P \leq .20$) in bivariate analysis were included in a multiple linear regression model to determine which were independently associated with changes in number of group B streptococcal disease cases. $P \leq .05$ in multiple linear

Table 1. Characteristics of Study Hospitals

Demographic	Mean no.	Percentage of mean no. of births
Births during 1996	1738	
Low birth weight (<2500 g) births	148	9
Premature (<37 wk) births	187	11
Births to black parturients	354	20
Births to white parturients	1147	66
Births to Hispanic parturients	130	7
Births to Asian parturients	91	5
Births to Native American parturients	5	0.3
Births to parturients who had ≥1 prenatal visit	1496	86
Births to uninsured parturients	84	5
Births to parturients receiving public medical assistance	557	32

Table 2. Obstetrics Programs of Study Hospitals

	No. of hospitals (N = 165)
Neonatal intensive care unit	89 (54)
Academic affiliation	53 (32)
Preprinted or computerized forms for records of prenatal visits	132 (80)
Microbiology laboratory on-site	155 (94)
Preprinted or computerized forms for labor and delivery admissions and clinical monitoring	158 (96)
Standing orders for antibiotic prophylaxis for group B streptococcal disease prevention	60 (36)
Capability of computerized retrieval of prenatal data	85 (52)
Any group B streptococcal disease prevention policy	96 (58)

Data are presented as *n* (%).

regression analysis was considered statistically significant.

We used χ^2 analysis to identify any associations between reference for hospital policy (ie, ACOG, CDC, or American Academy of Pediatrics reference) and methods of program implementation (eg, determining provider compliance with the policy, providing feedback to providers on compliance with the policy, or having the policy in writing).

Results

Of 177 hospitals under active surveillance for group B streptococcal disease during all of 1997, 165 (93%) completed the survey. The mean number of births in participating hospitals in 1996 was 1738 (Table 1). The mean numbers of group B streptococcal disease cases per hospital were 1.29 in 1996 and 0.95 in 1997. Fifty-three hospitals (32%) had academic affiliations (Table 2).

A detailed comparison of the survey's results with results of the 1994 survey was published.[11] The number of hospitals with a group B streptococcal disease prevention policy increased between 1994 and 1997. In 1997, 96 (58%) of 165 hospitals had group B streptococcal disease prevention policies (Table 2), compared with 35% in 1994. In 1997, 46% of institutions had written policies. Of those with policies, 48% followed the consensus guidelines' screening-based strategy (Table 3), 35% followed the consensus guidelines' risk-based strategy, and 7% used both strategies for determining who should receive intrapartum antibiotics.

Of the 96 hospitals with group B streptococcal disease prevention policies, many reported using more than one of the consensus guideline references as sources for their policies; 15 hospitals cited all three references. Three hospitals identified other sources for their policies. Overall, 67 hospitals identified the ACOG reference[9] as their source, 68 identified the CDC reference,[8] and 25 the American Academy of Pediatrics reference.[10] Nineteen hospitals identified only the ACOG reference, 20 only the CDC reference, and two only the American Academy of Pediatrics reference.

Of the 165 hospitals that completed the survey, 157 were under surveillance for all of 1996 and 1997 and were included in the paired *t* test analysis. At the 45 hospitals that established or revised their group B streptococcal disease prevention policies in 1996, there was a significantly lower mean number of group B streptococcal disease cases in 1997 than in 1996 (0.58 versus 1.29, $P = .006$) (Table 4). At the 66 hospitals that did not have group B streptococcal disease prevention policies, there was a lower mean number of group B streptococcal disease cases in 1997 than in 1996, but the difference was not statistically significant (1.09 versus 1.32, $P = .26$). Those hospital groups had similar mean numbers of births in 1996 (1672 at the hospitals that established or revised their policies in 1996 and 1720 at the hospitals without policies) and similar mean numbers of group B streptococcal disease cases during 1996

Table 3. Policy Characteristics of Study Hospitals With Any Group B Streptococcal Disease Prevention Policy

	No. of hospitals (n = 96)
Intrapartum antibiotic prophylaxis policy	
Screening	46 (48)
Risk based	34 (35)
Screening of all women	31 (32)
Cultures of vagina and rectum	46 (48)
Culture at 35–37 weeks	43 (45)
Selective broth media used at laboratory	74 (77)

Data are presented as *n* (%).

Table 4. Early-Onset Group B Streptococcal Disease Cases at Hospitals Under Active Surveillance in 1996 and 1997

Group B streptococcal disease prevention policy	No. of hospitals (n = 157)	Mean no. of births in 1996	Mean no. of cases*		$P^{\dagger}$
			1996	1997	
No policy	66	1720	1.32 (0.8)	1.09 (0.6)	.26
Policy revised or developed in 1996	45	1672	1.29 (0.8)	0.58 (0.3)	.006
Policy made or revised before or after 1996	46	2040	1.26 (0.6)	1.24 (0.6)	.94
Created at unknown date	11	1573	1.41 (0.9)	1.36 (0.9)	.60
Created before 1996, not revised	15	1184	0.87 (0.7)	0.93 (0.8)	.87
Created after 1996	20	2939	1.70 (0.6)	1.40 (0.5)	.51

* Values in parentheses are rates (number of early-onset cases per 1000 live births, with the mean number of births in 1996 as the denominator).
† Paired t test comparing number of cases in 1996 with number of cases in 1997.

(1.29 and 1.32, respectively). Mean numbers of group B streptococcal disease cases did not change from 1996 to 1997 at the 46 hospitals that had policies that were not made or revised in 1996 (1.26 versus 1.24, $P = .94$) nor in any of the three subgroups (creation date not known, creation before 1996, and creation after 1996).

The 165 hospitals that responded were under surveillance for all of 1997 and were included in the linear regression analysis. Linear regression with bivariate analysis, controlling for number of births, identified many factors possibly associated ($P \leq .20$) with the number of early-onset group B streptococcal disease cases. Possibly associated were location, racial distribution of women who gave birth, number of preterm births, presence of NICUs, number of women who had received at least one prenatal care visit, number of low birth weight infants, capability of computerized retrieval of prenatal laboratory data, having standing orders for antibiotic prophylaxis for group B streptococcal disease prevention, and having policies based on the ACOG statement (Table 5). Answering yes to "Does the obstetrics department at your institution have a policy regarding the prevention of neonatal group B streptococcal disease?" and identifying the CDC reference were not associated with the number of group B streptococcal disease cases ($P = .34$ and .65, respectively).

In multiple linear regression analysis, controlling for number of births, a hospital's having more black mothers was associated with a higher number of group B streptococcal disease cases ($P = .011$) (Table 5), and being born in Minnesota was associated with fewer group B streptococcal disease cases ($P = .002$). Identifying the ACOG reference as the source for the hospital policy was associated with fewer group B streptococcal disease cases ($P = .038$).

We compared policy implementation practices between the 19 hospitals that identified only the ACOG reference as the source for their policies and the 20 hospitals that identified only the CDC reference as the source for their policies (Table 6). A higher number of hospitals that cited only the ACOG reference determined policy compliance by health care providers (ten [53%] versus six [30%], $P = .15$) and significantly more ACOG-reference hospitals gave feedback to providers regarding compliance with policies (ten [53%] versus two [10%], $P = .005$). Physician training sessions were less common in hospitals that cited only the ACOG reference. We found no measurable association between source for policy and having a policy in writing, using the screening strategy, or using the risk-based strategy.

Discussion

Hospitals that established or revised their group B streptococcal disease prevention policies in 1996 had statistically significant decreases in numbers of group B streptococcal disease cases from 1996 to 1997. Hospitals that did not have group B streptococcal disease prevention policies and hospitals that did not establish or revise their policies in 1996 did not have statistically significant decreases in numbers of group B streptococcal disease cases during the same period. That suggests that the 1996 publication of the guidelines and their adoption by obstetrics programs were instrumental in decreasing the number of early-onset group B streptococcal disease cases.

The participation of ACOG, the opinion leader for obstetricians, in the consensus effort to develop group B streptococcal disease prevention guidelines was essential to the guidelines' success. The CDC, American Academy of Pediatrics, and ACOG documents all included the same recommendations, yet only citing the ACOG document as the source for policy, not citing the other documents, was significantly associated with disease reduction. This suggests that although persons responsible for obstetric practice at the institutional level turn to a variety of sources when setting policies, those who look only to ACOG more successfully influence obstetric practice. Active program implementation, including monitoring provider compliance and providing feedback, might underlie the association.

Table 5. Patient Demographics, Hospital Characteristics, Policies, and Policy Surrogates*

Characteristic	Bivariate linear regression analysis		Multiple linear regression analysis†	
	Parameter estimate	*P*	Parameter estimate	*P*
State				
Minnesota	−1.2	<.001	−1.0	.002
Maryland	0.48	.082		
Georgia	0.42	.15		
Tennessee	0.47	.17		
Connecticut	−0.25	.37		
Oregon	−0.15	.71		
California	−0.11	.73		
Race-ethnicity				
No. of black parturients	0.00086	.001	0.00066	.011
No. of Native American parturients	−0.021	.006		
No. of white parturients	−0.00041	.067		
No. of Asian parturients	−0.00089	.13		
No. of Hispanic parturients	−0.00063	.24		
Patient characteristics				
No. of premature births	0.0030	.001		
Neonatal intensive care unit	0.59	.017		
No. of parturients who had ≥1 prenatal care visit	0.0011	.078		
No. of births <2500 g	0.0020	.10		
No. of uninsured parturients	−0.0012	.32		
No. of parturients receiving public assistance	0.000022	.95		
Facility information				
Standing orders for antibiotic prophylaxis for group B streptococcal disease prevention	−0.51	.023		
Microbiology laboratory on-site	0.44	.33		
Academic affiliation	0.043	.86		
Policy				
Any policy for prevention of group B streptococcal disease	−0.21	.34		
Most recent policy modeled after ACOG guidelines	−0.63	.033	−0.44	.038
Most recent policy modeled after CDC published guidelines	0.14	.65		
Most recent policy modeled after American Academy of Pediatrics guidelines	0.042	.89		

CDC = Centers for Disease Control and Prevention.

* The number of births for each institution in 1996 was included as a covariate in both bivariate and multivariable models.

† Results shown only for significant ($P \leq .05$) predictors of early-onset group B streptococcal disease cases.

‡ Characteristic not significant in multiple linear regression analysis.

The consensus guidelines did not include recommendations about policy implementation. Individual hospitals determined what methods to use. Hospitals that cited the ACOG reference as the source for their policies chose to monitor compliance and provide feedback independent of any guideline recommendations. This study suggests that training is not as critical to success of group B streptococcal disease prevention programs as monitoring compliance and providing feedback, or that training without measuring compliance is not adequate.

In our analysis, the group of hospitals without formal policies showed some decrease in mean numbers of group B streptococcal disease cases between 1996 and 1997. We suspect that the decrease was due to changes among individual practitioners.

Universal adoption of policies regarding intrapartum antibiotic therapy might reduce racial disparity in disease burden. In our analysis, institutions with more black patients had more cases of group B streptococcal disease. The reason for that was unclear but might be related to higher rates of group B streptococcal carriage among black women[1,2,7,12] than among women of other racial or ethnic groups. The reason for higher rates of carriage is not known.

We do not know why neonates born in Minnesota were at decreased risk of acquiring group B streptococcal disease. It might be due to variables that were not measured in this study, such as better compliance with group B streptococcal disease prevention policies among individual practitioners or a low-risk obstetric population independent of race.

There were several limitations to this study. The survey did not document actual practices but relied on self-report. Inaccurate responses likely would have reduced our ability to find any associations. We did not have a large enough sample to differentiate between types of policies, such as screening and risk-based approaches.

The CDC and ACOG statements were published on May 31 and June 1, 1996, respectively, and the American Academy of Pediatrics statement was published in March 1997. In hospitals that based their policies solely on the latter reference, there might not have been measurable effects on number of group B streptococcal disease cases in 1997 because of the late policy adoption. Identifying whether the American Academy of Pediatrics reference was instrumental in decreasing the number of group B streptococcal disease cases was not possible when looking at 1997 data because only two hospitals in the study identified that reference as the sole source for their policies. For the analysis whose results are summarized in Table 4, we compared numbers of group B streptococcal disease cases in 1996 with numbers of group B streptococcal disease cases in 1997. Given that the CDC and ACOG statements were published in May and June 1996, it is likely that some group

Table 6. Program Implementation Differences Between Hospitals Citing Only ACOG Guidelines and Hospitals Citing Only CDC Guidelines as Sources for Policies*

Program implementation characteristic	Only ACOG guidelines (n = 19)	Only CDC guidelines (n = 20)	P
Determination of provider compliance with policy	10 (53)	6 (30)	.15
Provision of routine feedback on compliance to providers (either individual or aggregate with policy)	10 (53)	2 (10)	.005†
Group B streptococcal disease prevention policy in writing	15 (79)	14 (70)	.72†
Standing orders for antibiotic prophylaxis for group B streptococcal disease prevention	9 (47)	10 (50)	.86
Capability of computerized retrieval of prenatal laboratory data by clinicians at labor and delivery	14 (74)	12 (60)	.50†
Nurse in-service training regarding policy	10 (53)	13 (65)	.43
Physician training sessions regarding policy	10 (53)	18 (90)	.01†
Screening strategy used	7 (37)	7 (35)	.91
Risk-based strategy used	8 (42)	9 (45)	.86

Abbreviation as in Table 5.
Data are presented as n (%).
* χ^2 analysis.
† Fisher exact test.

B streptococcal disease cases were prevented during 1996. It is possible that the 1996 number is an underestimate of the true number of cases before institution of group B streptococcal disease prevention policies, which would mean that the true impact of adopting a group B streptococcal disease prevention policy during 1996 was underestimated.

Hospital policies can improve disease prevention, so we need to ensure that policies are adopted. Policy adoption and implementation involve collaboration between obstetricians, pediatricians, microbiologists, infection control personnel, and nurses. The effectiveness of group B streptococcal disease prevention policies might improve with monitoring of compliance and provision of feedback to clinicians. Early-onset group B streptococcal disease is largely preventable with currently available methods. Until better strategies exist, such as use of group B streptococcal vaccines, many institutions need to improve compliance with recommended strategies.

References

1. Zangwill KM, Schuchat A, Wenger JD. Group B streptococcal disease in the United States, 1990: Report from a multistate active surveillance system. MMWR Morb Mortal Wkly Rep CDC Surveill Summ 1992;41:25–32.
2. Centers for Disease Control and Prevention. Decreasing incidence of perinatal group B streptococcal disease—United States, 1993–1995. MMWR Morb Mortal Wkly Rep 1997;46:473–7.
3. Boyer KM, Gotoff SP. Prevention of early-onset neonatal group B streptococcal disease with selective intrapartum chemoprophylaxis. N Engl J Med 1986;314:1665–9.
4. Garland SM, Fliegner JR. Group B streptococcus and neonatal infections: The case for intrapartum chemoprophylaxis. Aust N Z J Obstet Gynaecol 1991;31:119–22.
5. American Academy of Pediatrics. Guidelines for prevention of group B streptococcal infection by chemoprophylaxis. Pediatrics 1992;90:775–8.
6. American College of Obstetricians and Gynecologists. Group B streptococcal infections in pregnancy. ACOG technical bulletin no. 170. Washington, DC: American College of Obstetricians and Gynecologists, 1992:1–5.
7. Whitney CG, Plikaytis BD, Gozansky WS, Wenger JD, Schuchat A. Prevention practices for perinatal group B streptococcal disease: A multi-state surveillance analysis. Obstet Gynecol 1997;89:28–32.
8. Centers for Disease Control and Prevention. Prevention of perinatal group B streptococcal disease: A public health perspective. MMWR Morb Mortal Wkly Rep 1996:1–24.
9. American College of Obstetricians and Gynecologists Committee on Obstetric Practice. Prevention of early-onset group B streptococcal disease in newborns. ACOG Committee opinion no. 173. Washington, DC: American College of Obstetricians and Gynecologists, 1996.
10. American Academy of Pediatrics and COID/COFN. Revised guidelines for prevention of early-onset group B streptococcal (GBS) infection. Pediatrics 1997;99:489–96.
11. Centers for Disease Control and Prevention. Adoption of hospital policies for prevention of perinatal group B streptococcal disease—United States, 1997. MMWR Morb Mortal Wkly Rep 1998;47:665–70.
12. Schuchat A, Oxtoby M, Cochi S, Sikes RK, Hightower A, Plikaytis B, et al. Population-based risk factors for neonatal group B streptococcal disease: Results of a cohort study in metropolitan Atlanta. J Infect Dis 1990;162:672–7.

Address reprint requests to:
Cynthia G. Whitney, MD, MPH
Respiratory Diseases Branch
Division of Bacterial and Mycotic Diseases
National Center for Infectious Diseases
Mailstop C-23, 1600 Clifton Road NE
Atlanta, GA 30333
E-mail: cgw3@cdc.gov

Received April 23, 1999.
Received in revised form August 31, 1999.
Accepted September 2, 1999.

Published by Elsevier Science Inc.